REMARKS

Applicant has amended the claims to clarify the present invention. Claims 2 and 3 have been canceled. Claims 1, 4 and 5 remain for prosecution.

As amended, Claim 1 is to a a method of producing steel using a steel-making vessel, where lime is used as a flux material that is blown, from above, into a steel-making bath along with an oxygen stream. The improvement provides a flux material composition having a particle size of less than 250 mesh, the composition being a mixture of conditioned high calcium quicklime and conditioned dolomite quicklime, each conditioned by separately pulverizing the same to the particle size and coating with the flow aid. The flow aid material is an organic siloxane, and is present in an amount of less than 0.5 percent by weight of the composition, and the flux material composition is injected through a lance along with oxygen into the steel-making bath contained in the vessel.

In the Office Action, Claims 1-5 were rejected as obvious under 35 U.S.C. §103(a) in view of Applicants' admitted Prior Art when combined with Okane et al. (U.S. Patent No. 4,541,617), Zebrowski (U.S. Publication 2004/0083851) and Nicholson (U.S. Patent No. 4,208,388). Reconsideration and removal of this rejection are respectfully requested in view of the present claim amendments and the following remarks.

In rejecting the claims, the Office Action asserts that it is admitted that it is known to add lime to molten metal in a steelmaking vessel via oxygen lances. The Office Action admits that the admitted Prior Art does not teach adding from above, the particle size of the lime or the flow aid material as specified in Claim 1.

The Office Action then cites Okane et al. to teach blowing, where the blowing includes adding flux such as dolomite and quicklime in powdered form (column 1, lines 22-27), and asserts it would have been obvious to add oxygen and flux from above in the process of the admitted prior art as taught by Okane et al, since Okane et al. teaches that this type of blowing promotes dephosphorization and desulfurization, and also use of dolomite and quick ime (high calcium line) as types of lime materials. Regarding the particle size, the Office Action states that Zebrowski teaches a method of removing sulfur from molten iron using a calcium compound including CaO. The mesh size is 14-500 mesh (see paragraph 0018), and it is alleged it would have been obvious to use the particle size taught by Zebrowski in the process of the admitted Prior Art, since Zebrowski teaches that the particle size is selected to provide the necessary activity or reactivity with the sulfur in the molten iron. Nicholson is then cited to teach enhancing the flowability of lime by treating with polymethylhydrogensiloxanes and polydimethylsiloxanes, and the Office Action alleges it would have been obvious to add the flow aid of Nicholson in the process of the admitted prior art, since Nicholson teaches enhancing flowability for long periods of time and exposure to high humidity (column 2, lines 26-30).

Briefly, the Okane et al. reference is a basic teaching of injecting lime using an oxygen lance, while Zebrowski is used to teach the benefit of using a calcium desulfurization agent having a particle size of less than 325 mesh. The teachings of Nicholson describe addition of an organic siloxane, such as polydimethylsiloxane, in an amount of 0.025 to 0.5 parts by weight, to a particulate lime so as to enhance the flowability of the lime.

Initially, Applicant would point out that there is a difference in the process of "blowing" lime into a BOF molten bath using a "Laval nozzle" so that it interacts with the supersonic oxygen jets in the molten slag versus "injecting" lime using oxygen as the carrier gas at supersonic rates in a "non-Laval nozzle" penetrating a molten bath. The lime is also surrounded by oxygen jets in the tip of the lance as a shield to prevent flaring of lime particles.

In Okane et al., Laval nozzles (24) blow oxygen gas, and flux feeding ports (22c) of the flux supply tube (22) for feeding exits (24a) of the Laval nozzles (24) are provided, the flux consisting of one of quicklime, fluorite, dolomite and iron ore, with the slag-forming powdered flux having a diameter of 9 mm (col. 6, lines 1-5).

In the past, attempts to introduce lime through an oxygen lance for the BOF process resulted in minimal amounts of lime added at lower feed rates due to the 9 mm diameter of the flux lime, while the majority of the lime was top charged. Typical additions amounted to about 2,000 lbs. compared to 100% of the BOF lime requirements being proposed to be injected with the limelance system. With newer lances, using a 76 mm diameter nozzle for lime, lime dispenser system and flow aided lime using siloxane, the rate of injection is 2,000 lbs/minute vs. 500 lbs/minute typical in the past. The issues then were plugging of lines with the lime treated by the ethylene glycol flowaid. In the past, a typical flowaid used for pulverized lime was ethylene glycol which could impact flowability of lime by hydration. Use of siloxane reduces this tendency and the addition into the pulverized lime is unique for blended dolomitic and high calcium product for injection, The present

technique requires separate grinding and flowaid additions to both the dolomitic and high calcium lime prior to blending, as now specified in amended Claim 1.

The Zebrowski reference, on the other hand, relates to desulfurization using Mg and CaO powder and is used at the hot metal desulfurization station where the material is co-injected through a refractory lance with a pipe used for the injection into a ladle with dilute phase instead of dense phase injection that is proposed at present. This dilute phase is not practiced at the BOF furnace. The purpose in Zebrowski is to reduce the sulfur content prior to sending to the BOF furnace for refining.

In the present dense phase method, the lime is not contacting the molten steel bath (blown, from above). The desulfurizing agent used in Zebrowski's method is reclaimed magnesium, a gas producing compound and a calcium compound.

Nicholson is a general teaching of enhancing the flowability of lime by addition of siloxane.

None of the references, or their combination, however, teach the present method where a flux material is blown from above into a steelmaking bath along with oxygen, where the flux material has a particle size of less than 250 mesh, and where the composition is a mixture of conditioned high calcium quicklime and conditioned dolomitic quicklime, each conditioned by separately pulverizing the same to the desired particle size and coating with an organic siloxane, with the advantages provided.

In view of the above remarks and the amendments to the claims, Claims 1. 4 and 5 are believed to be patentable and in condition for allowance.

In the event that any fees are due in connection with this paper, please charge our Deposit Account No. 16-0485.

Respectfully submitted,

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